INSTRUCTION MANUAL

VARI-SWEEP 860-E w/P-860 Head

KAY ELECTRIC CO.
PINE BROOK, N. J.

Operating
and Maintenance Manual

June, 1962

Issue A

VARI-SWEEP

Catalog No. 860-D

Catalog No. 860-E supersedes 860-D, and accepts a wider range of plug-in units.

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SECTION I
FUNCTION AND DESCRIPTION

1.1 INTRODUCTION.

The Vari-Sweep Model 860-D contains the sweep generating, agc, power supply and output circuits for any one of several plug-in sweeping oscillator units. The instrument is designed for either bench-top operation or for mounting in a standard 19-inch relay rack.

Up to one volt rms swept frequency output (across approximately 70 ohms, 50 ohms on request) is generated. A blanking circuit turns off the output of the instrument during retrace time to provide a zero-voltage reference baseline on the scope. Fast-acting agc circuits hold the output constant within ±0.5 db over the widest sweep.

A line-lock sweep repetition rate is available for general use, as well as variable rates between 1.0 and 25 cps in two ranges. The variable rates are useful for investigating high-Q circuits, which sometimes exhibit sharp variations in amplitude response and are sometimes not discernable with the faster fixed rep rate. A manual sweep is also provided allowing the operator to range back and forth across any portion of the response curve of a circuit at any desired rate. This feature is particularly useful when a frequency counter is used to measure the exact frequency of any point along the response curve. The manual sweep is also useful when used with an X-Y recorder to produce a permanent record of the response curve. A c-w signal is available when the sweep function is not being used and appears at the same jack as the swept r-f output.

A sawtooth signal, synchronized with the swept output, is available at the SWEEP OUT terminal and is used to drive the X-axis amplifiers of the cathode-ray oscilloscope. This provision eliminates the necessity of using the internal sweep of the scope, thus dispensing with any phasing adjustments.

A calibrated, precision, step, attenuator provides up to 59 db attenuation. Through its use, quantitative amplitude measurements, in terms of db level, may be made directly on the CRO. A gain control provides an additional, continuously variable 6-db increment of attenuation, permitting the selection of any output level within a 65-db range.

1.2 SPECIFICATIONS.

Sweep Rates:

a. Manual Sweep
b. Variable Rates - 1.0 to 5.0 cps, 5.0 to 25 cps.
c. Line Lock

Sweep Output: Regular sawtooth, 7 volts peak, at a nominal 3000 ohms.

CW Output: (Frequency range dependent on plug-in).

Attenuation: Fixed 20 db, 20 db, 10 db, 6 db, 3 db.
Variable 6 db (approx.).

Output Impedance: Nominal 70 ohms (50 ohms on request).

Power Input Requirements: 100 watts (approx.), 117 volts (±10%), 50 to 60 cps. B+ electronically regulated.

1.3 EQUIPMENT SUPPLIED.

The Vari-Sweep Model 860-D is furnished in a metal cabinet and is shipped complete with built-in power supply. Other auxiliary equipment and interconnecting cables referred to in this manual are not furnished.

SECTION II
INSTALLATION

2.1 GENERAL INSTRUCTIONS.

When the Vari-Sweep 860-D is received, it should be visually inspected to determine that the instrument was not damaged during shipment. A careful check of the packing case contents should be made to insure removal of all items shipped. Shortage or damage should be reported immediately to the carrier and Kay Electric Company or its representative in the area.

2.2 INSTALLATION.

Installation of the Vari-Sweep Model 860-D presents no particular problems since the instrument is designed for either bench-top operation or for mounting in a standard 19-inch rack. It is recommended that sufficient space be allotted to avoid obstruction of the ventilating grill-work. Space should also be provided for the auxiliary equipment. The operating area selected should be as free as possible from vibration due to the presence of machinery or other sources of vibration. Extreme variations of ambient temperature or an excessively humid environment should be avoided. Observation of these precautions will result in the user realizing optimum performance of the equipment.

2.3 INSERTION AND REMOVAL OF PLUG-IN UNIT.

The plug-in units are provided with a multi-connector plug and a coaxial connector which are accepted by jacks located at the rear of the receiving well. To insert the plug-in unit, merely push it into the receiving well as far as it will go to engage the connectors. The locking knob located at the bottom of the plug-in panel is then turned clockwise until it is tight. Removal is accomplished by turning the locking knob counterclockwise until it is fully disengaged. The unit may then be pulled from the rack.

2.4 INTERCONNECTIONS.

Interconnections between the Vari-Sweep Model 860-D, the associated equipment and the device under test, will be determined, at least partially, by the requirements of the tested device. The use of coaxial cable is recommended, where indicated, to avoid pick-up of spurious signals. All leads should be kept to minimum length consistent with the placement of the equipment on the bench. The use of appropriate coaxial connectors at the cable ends will assure a good common ground between the equipment and proper shielding at the terminations.

SECTION III
FUNCTION OF CONTROLS AND TERMINALS

3.1 EXTERNAL CONTROLS.

CONTROL	POSITION	FUNCTION
Power ON-OFF Switch (S-1)	ON	In the ON position, a-c power is applied to transformer T-1, energizing the circuits in the rack and plug-in unit.
	OFF	In the OFF position, a-c power is removed from power transformer T-1 and the instrument is de-energized.
SWEEP SELECTOR Switch (S-2)	CW	When the SWEEP SELECTOR is in the CW position, the sweep generating circuits are disabled and no saw-tooth signal is available at the SWP OUT jack J-1. The sweeping oscillators in the plug-in unit are then free to operate at their natural frequency, providing a c-w signal at the RF OUTPUT jack J-2.
	MANUAL	When the SWEEP SELECTOR is set to MANUAL position, the sweep generating circuits are disabled and the MANUAL SWEEP control is used to vary oscillator frequency.
	VAR 1-5 VAR 5-25	When the SWEEP SELECTOR is set to one of the variable sweep rate positions, the SWEEP RATE control may be used to establish the sweep rep rate at any rate within the selected range.
	LINE LOCK	In LINE LOCK position, the SWEEP RATE control is ineffective and the rep rate is fixed at power-line frequency
MANUAL SWEEP	Variable	When the SWEEP SELECTOR is set to MANUAL position, the output frequency available at RF OUTPUT jack J-2 may be varied with the MANUAL SWEEP control over a range determined by the setting of the SWEEP WIDTH control, and control settings made on the plug-in unit.
SWEEP RATE Pot (R-30)	Variable	When the SWEEP SELECTOR is set to one of the variable sweep rate positions, the SWEEP RATE control is used to vary the sweep repetition rate over the selected range.
RF LEVEL Pot (R-50)	Variable	This control provides 6 db of variable attenuation ahead of the RF OUTPUT jack.

CONTROL	POSITION	FUNCTION
Attenuator Switches (S-3 thru S-7)	Stepped	Stepped attenuation of 3, 6, 10, 20 and 20 db is provided permitting the operator to lower the amplitude of the output signal by a fixed, known amount.
SWEEP WIDTH Pot (R-40)	Variable	This control is used to adjust the sweep width and is effective for all positions of the SWEEP SELECTOR except CW position.

3.2 INTERNAL CONTROLS.

CONTROL	POSITION	FUNCTION
60 CPS LINE LOCK Pot (R-33)	Variable	This control is used to set the sweep repetition rate of the instrument at line frequency when the SWEEP SELECTOR switch is set to the LINE LOCK position.
SYNC LOCK Pot (R-8)	Variable	The SYNC LOCK control is used to synchronize the output of Schmitt trigger V-1 at line frequency.
B+ ADJ Pot (R-94)	Variable	This control is used to set the electronically regulated B+ supply voltage at 250 volts.
6 DB ADJ Pot (R-48) & AGC ADJ Pot (R-51)	Variable	These controls are used to establish the range of the RF LEVEL control.

3.3 TERMINALS.

TERMINAL	FUNCTION
RF OUT Jack (J-2)	Both the swept r-f output and the c-w output are available at this BNC-type jack at a characteristic impedance of 70 ohms (50 ohms on request). If the input impedance of the device to which this instrument is connected differs substantially from 70 ohms, an impedance matching circuit should be connected between the Vari-Sweep and the device being examined.
SWEEP OUT Terminal (J-1)	A sawtooth voltage, synchronized with the swept r-f output, is available at this GR-type terminal and is normally used to drive the X-axis amplifiers of the CRO.

SECTION IV
OPERATION

4.1 INTRODUCTION.

The frequency range of the c-w output and the swept r-f output is determined by the characteristics of the plug-in used. The regulated power supply built into the Vari-Sweep 860-D furnishes all power for the basic unit and the plug-in used. Separate operating instructions are furnished with the plug-in units.

4.2 C-W OPERATION.

For C-W operation, the SWEEP SELECTOR must be set to the CW position. The frequency range of the c-w output is determined by the individual plug-in unit. The RF LEVEL control and step attenuator are used to adjust the amplitude of the c-w signal available at RF OUTPUT jack J-2.

4.3 MANUAL SWEEP OPERATION.

For manual sweep operation, the SWEEP SELECTOR must be set to MANUAL position. In this mode of operation, the center frequency of the manual sweep is determined by the setting of the frequency controls contained on the plug-in unit. By varying the MANUAL SWEEP control the oscillator output frequency is changed accordingly, within a range determined by the setting of the SWEEP WIDTH control.

This feature permits the operator to range across any portion of the response curve, as seen on the CRO, at a repetition rate determined only by the speed at which the MANUAL SWEEP control is rotated. If it is desired to determine the frequency of a particular point on the response curve, the MANUAL SWEEP control is adjusted until the spot shown on the scope screen is located at the point of interest. The frequency of the Vari-Sweep is then read directly on a counter.

Another advantage of the manual sweep is that it may be used with X-Y recorders to produce permanent records. These records may be kept for minute inspection or for comparison with other records of the same response curve.

4.4 VARIABLE REPETITION RATES.

Variable repetition rates between 1 and 25 cps are provided. (See Section 3.1). The SWEEP RATE control provides adjustment within the range selected by the SWEEP SELECTOR. The repetition rate selected should be fast enough for practical retention of the pattern as seen on the CRO, while still maintaining the correct response curve. A long persistent cathode-ray tube (P-7) in the oscilloscope is desirable for slow sweep rates.

The variable rep rates are useful when observing the response curve of a device exhibiting sharp variations in output amplitude. In such cases, the slower repetition rates will show the sharp variations, which the faster repetition rates may not "see". Another advantage of the variable repetition rates becomes apparent when a device exhibiting 60 cps hum is being examined. When such a circuit is being swept at a 60 cps rate, or a rate which is a harmonic or submultiple of 60 cps, a distorted response curve is produced. If the repetition rate is changed to a rate other than 60 cps, or other than one of its harmonics of submultiples, the response curve will start into oscillation. In this way, the variable repetition rate function may be used to detect the presence of hum in a circuit.

4.5 ATTENUATOR.

By using the attenuator, a reference can be established on the CRO for voltage levels below the average signal level, in terms of db, without the necessity of external measuring devices. Such useful information as the "3 db down point" can be obtained directly by using the precision attenuator. The RF LEVEL control provides 6-db of variable attenuation permitting the operator to select any desired output level within the range of the instrument.

SECTION V
CIRCUIT DESCRIPTION

5.1 INTRODUCTION.

This section contains a general discussion of the 860-D circuitry. A discussion of the plug-in circuitry is furnished in the instruction sheets furnished with the individual plug-ins.

5.2 GENERAL DISCUSSION OF CIRCUITRY.

The Vari-Sweep consists of four basic circuit sections, viz, power supply, sweep circuits, agc circuits and attenuator. The P-860 plug-in unit consists essentially of a sawtooth amplifier, push-pull oscillator and switch turret containing the frequency determining tank coils for the oscillator. (See Fig. 6.3, Schematic D-7367). The overall frequency range of the Vari-Sweep is determined by the characteristics of the selected plug-in unit. Other plug-in units use different oscillator circuits.

A. Sweep Circuits.

Sweep generator V-2 operates as a screen-coupled Phantastron which receives triggering pulses from Schmitt Trigger V-1. Either a fixed line-lock or a choice of two variable rep-rate ranges may be used, according to the setting of the Sweep Selector.

When the Sweep Selector is set for Manual operation, plate voltage is removed from the Schmitt Trigger, and Phantastron screen coupling is opened disabling the sweep circuits (V-1, V-2). Since there is d-c coupling between the Manual Sweep control and the grid of V-301, the Sawtooth Amplifier, the Manual Sweep control can be used to change the grid bias and thus the current through V-301 and the voltage drop across R-328, the plate load, which in turn causes a change of inductance in L-303, the sweep yoke in the plug-in unit. The center tapped secondaries of the sweep yoke are the tank coils for the push-pull oscillator (V-302, V-303) and therefore, a change of inductance will cause a change in oscillator frequency.

Emitter-follower stage Q-1 is used as a power amplifier to provide a low impedance output for the sawtooth voltage (or varying d-c in manual sweep operation) for application to the X-axis amplifiers in the CRO. Diode D-1 is a d-c restorer providing a negative blanking pulse to cut off the sweep oscillator (V-302, V-303) during CRO retrace time.

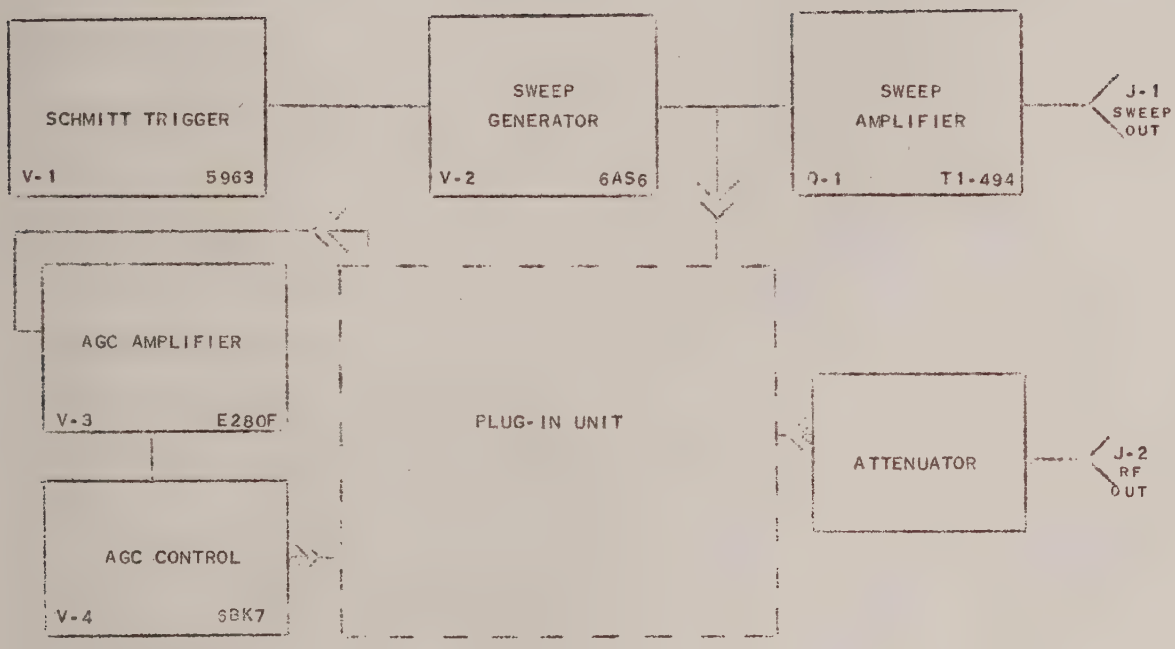

FIG. 5.1, FUNCTIONAL BLOCK DIAGRAM, VARI-SWEEP 860D.

B. AGC Circuits.

Both the sweeping r-f output and the c-w output are held constant within ±0.5 db by a fast-acting agc circuit. In operation, a sample of the oscillator output is detected in a voltage doubler (D-303, 304 and C-311, 312) and applied to the input grid of V-3, the first AGC Amplifier. After amplification the agc voltage is applied to AGC Control tube V-4, a parallel-connected cathode follower. The voltage taken from the cathodes serves as a correction voltage, compensating for amplitude variations of oscillator output. The correction voltage is applied to the center tap of the oscillator tank coils.

Diode D-3 is used to prevent the grids of V-4, and thus oscillator plate voltage, from rising above 150 volts during the blanking sequence.

SECTION VI
MAINTENANCE

6.1 INTRODUCTION.

A procedure for inspecting the equipment when received, or for periodic maintenance is furnished in this section.

Equipment Required

Cathode-ray Oscilloscope (Tektronix 503, or equivalent).

Detector (See Fig. 6.1).

V.T.V.M. (VoltOhmyst, or equivalent).

RF Voltmeter (Hewlett-Packard 400H, or equivalent).

6.2 ADJUSTMENT OF CIRCUIT VARIABLES.

A. Adjustment of B+.

Step 1. Set the ON-OFF switch to ON position and allow about 15 minutes for the instrument to warm-up and stabilize.

Step 2. Connect the VTVM between the junction of R-91, C-28 and chassis ground.

Step 3. Vary B+ Adj pot (R-94) until a reading of +250 volts is indicated on the VTVM.

B. Check-out of Sweep Repetition Rates.

Step 1. Provide a connection between the SWEEP OUT terminal and the vertical input terminal on the CRO.

Step 2. Set the CRO Y-axis controls for d-c operation.

Step 3. Set the SWEEP SELECTOR to LINE LOCK.

Step 4. Use calibrated time base of scope.

Note:- If the CRO does not have a calibrated time base, connect the SWEEP OUT terminal to the Y-axis terminal and connect the output of an audio oscillator to the X-axis terminal. Lissajous patterns may then be used to measure the 28 and 30 cps repetition rates. The Lissajous patterns obtained will not be the usual circles or ovals, but will be somewhat distorted due to the sawtooth output of the Vari-Sweep.

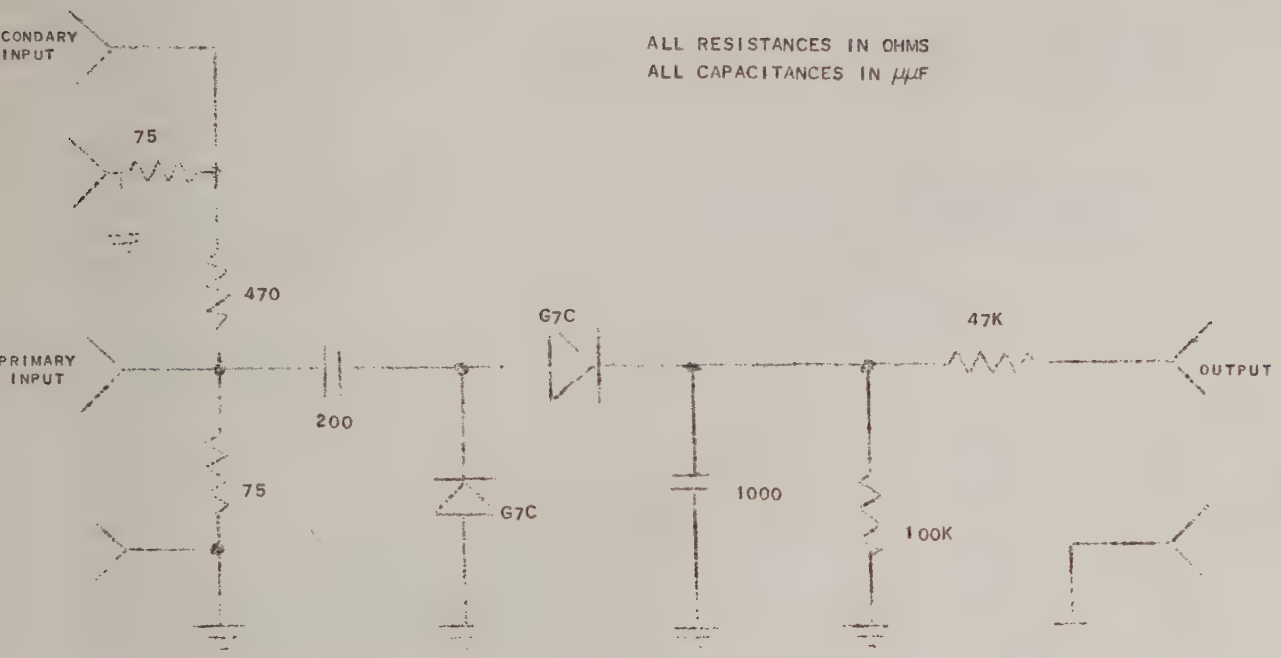

FIG. 6.1, R-F DETECTOR.

Step 5. Observe that the sawtooth duration time remains locked in at 16 milliseconds throughout entire range of SWEEP RATE control.

Step 6. Set SWEEP SELECTOR to VAR 5-25 and SWEEP RATE control fully clockwise.

Step 7. Observe that the sawtooth duration time is less than 40 milliseconds (indicating a repetition rate greater than 25 cps).

Step 8. Set the SWEEP RATE control fully counterclockwise.

Step 9. Observe that the sawtooth duration time is greater than 0.2 seconds (indicating a repetition rate less than 5.0 cps).

Follow a similar procedure for checking the VAR 1-5 rate. (When the SWEEP RATE control is fully clockwise the sawtooth duration time should be less than 0.2 seconds. When the SWEEP RATE control is fully counterclockwise, the sawtooth duration time should be greater than one second).

C. Check-out of Manual Sweep.

Step 1. Set SWEEP SELECTOR to VAR 1-5 and note the amplitude of the vertical deflection on the scope.

Step 2. Set SWEEP SELECTOR to MANUAL.

Step 3. Vary the MANUAL SWEEP control through its entire range and see that the spot ranges over a 10% greater vertical deflection than the deflection observed in Step 1.

D. Check-out of AGC and Output Circuits.

Step 1. Insert plug-in unit in rack.

Step 2. Connect circuit as shown in Fig. 6.2

Step 3. Set Vari-Sweep controls as follows:

SWEEP SELECTOR: LINE LOCK
SWEEP WIDTH: Fully clockwise
Attenuation: All out

Step 4. A calibrated detector is required for a check-out of the agc and output circuits. A suitable detector is described in Fig. 6.1 and must be calibrated for one volt rms. In order to calibrate the detector, the c-w output from the Vari-Sweep 860-D is used, plus a broad-band voltmeter. The voltmeter is connected across the input of the detector and the output is connected to the vertical input terminal of the scope. The cw output frequency of the 860-D should be set for approximately 2 mc and amplitude adjusted until the voltmeter indicates a reading of one volt rms. The vertical gain controls of the scope are then adjusted to provide a convenient voltage reference. To check the input amplitude to the detector, the setting of the vertical gain controls are left undisturbed and, if the vertical deflection is equal to the reference deflection, a one volt input is being applied to the detector.

With the equipment interconnected as in Fig. 6.2, and controls set as in Step 3 above, adjust the RF LEVEL control for 1 volt rms output as indicated on the CRO. If 1 volt rms is not obtained, adjust R-51, AGC ADJUST control (internal). Observe that the output meter reads 1 volt rms. If it does not, adjust the Meter Adj control, located internally on the plug-in unit, for 1 volt rms.

Step 5. Switch in 6 db attenuation and note vertical deflection of scope trace.

Step 6. Switch out 6 db attenuation and turn the RF LEVEL control fully counterclockwise. Vertical deflection should be slightly less than that observed in step 5. If not, adjust R-48, 6 DB ADJUST (internal).

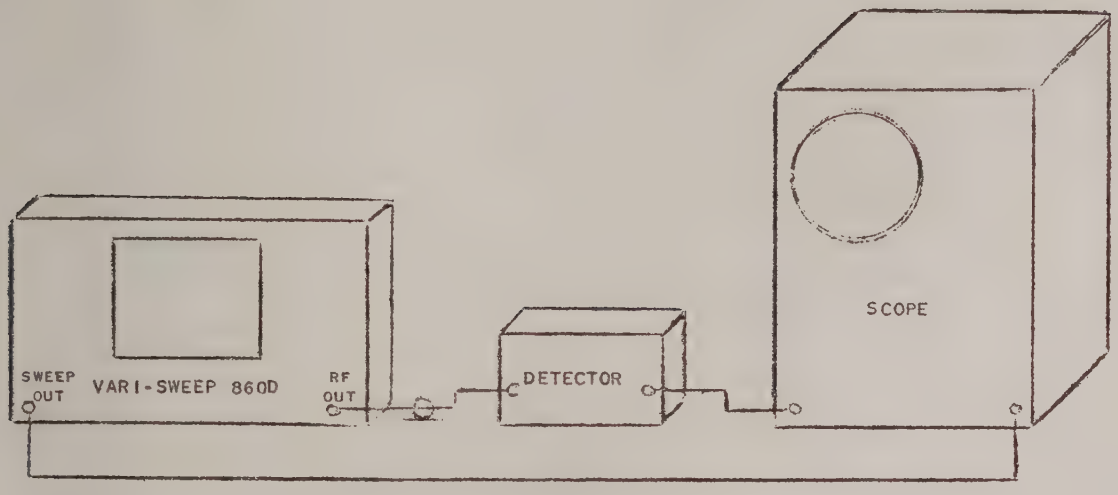

FIG. 6.2, EQUIPMENT INTERCONNECTIONS FOR CHECKING AND ADJUSTING AGC CIRCUITS.

V1
5963
SCHMITT TRIGGER

V2
6W6
SWEEP GEN

Q1
TI-494
SWEEP AMPL

301 BAND SELECTOR

METER ADJ (INT)

V301
6CL6
SAWTOOTH AMPL

V3
E280F
AGC AMPL

V7
12AU7

V8
12AX7

V9
5651

ATTENUATOR 75 OHMS

NOTE:
UNLESS INDICATED OTHERWISE
ALL RESISTANCES ARE IN OHMS
ALL CAPACITANCES ARE IN μμf
FACTORY SELECTED

AUA S/NO 23931

SCHEMATIC | VARI-SWEEP 860E

MAT. | FINISH: | SCALE:

DIMENSION TOLERANCES UNLESS OTHERWISE SPECIFIED.
DECIMAL DIMENSIONS ± .005 FRACTIONAL DIMENSIONS ± 1/64

CHANGE	DATE	APP.
B ECN 698	4-10-62	
C ECN 709	6-5-62	
D ECN 714	6-20-62	

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DWN. BY [illegible] DATE 4-13-62
APP BY [illegible] DATE 5-2-62

DWG. NO. D 7367F

June, 1962

SWEEPING OSCILLATOR

PLUG-IN UNIT

MODEL P-860

Issue A

NOTE: This sweeping oscillator plug-in unit is now compatible with both the Marka-Sweep Model Pi and Vari-Sweep Model 860-E, basic rack units.

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KAY ELECTRIC COMPANY
Pine Brook, N. J.
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INTRODUCTION.

Model P-860 is a sweeping oscillator plug-in unit designed for use with the Vari-Sweep Model 860-D. All operating signals and power for the P-860 is provided by the 860-D. The frequency range of 2 to 215 mc is covered in 12 bands, with sweep widths variable up to 30 mc. Major circuitry consists of a sawtooth amplifier, oscillator circuits and an age detector. (Schematic D-7367A).

OPERATION.

An operating procedure is provided here as a guide for general application, the main purpose of which is to illustrate the use of the Vari-Sweep 860-D in conjunction with the P-860 plug-in. If maximum utility is to be obtained from the instrument, deviations from this procedure will be necessary, according to the measurements being made and the type of equipment being tested. The operator should become familiar with the function of all operating controls.

Allow several minutes warm-up time to stabilize the circuits after the ON - OFF switch has been set to ON. For most applications, the interconnection diagram shown in Fig. 1 may be used. The SWEEP SELECTOR switch should be set to the desired mode of operation. The Band Selector switch and the Center Frequency control should be set to the center frequency of the pass-band of the equipment being tested. The SWEEP WIDTH control is usually adjusted to provide about three times the width of the pass-band of the tested equipment. The RF LEVEL control and attenuator may be used to adjust the amplitude of the output signal.

SPECIFICATIONS.

Frequency Range: 2 to 215 mc in 12 bands.

Output: 1 volt rms.

Flatness: $\pm$0.5 db over each band.

Sweep Width: 30 mc, with center frequencies above 50 mc;
60% of center frequency, with center frequencies below 50 mc.

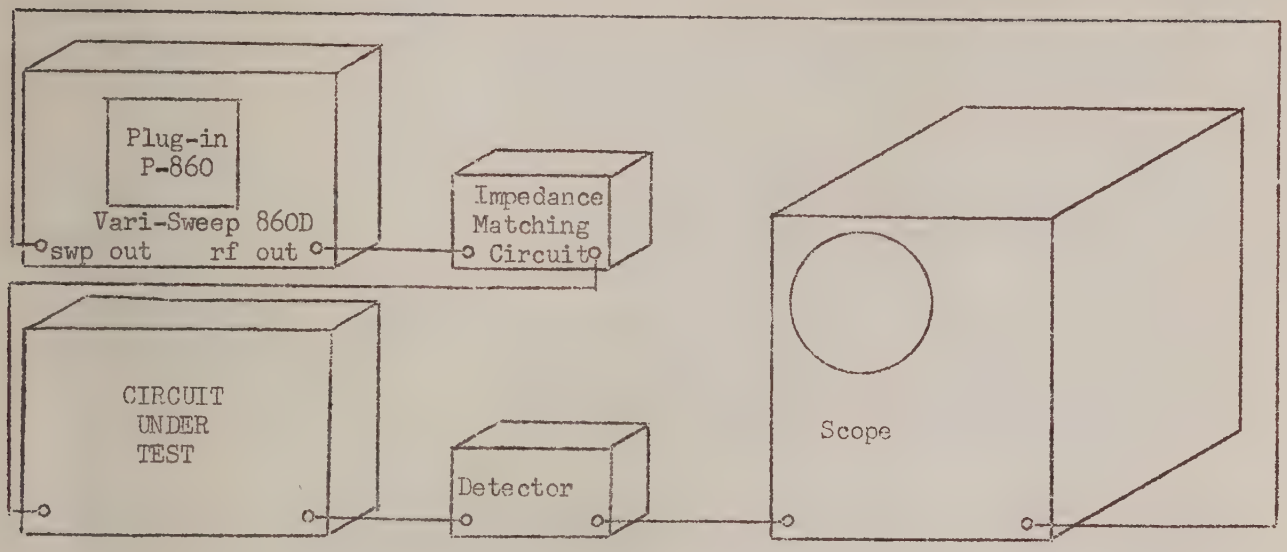

Fig. 1, Equipment Interconnection Diagram.

CONTROLS AND TERMINALS.

CONTROL	POSITION	FUNCTION
Band Selector switch, S-301	12 positions	This control is used to select the frequency range for electronic sweep, Manual Sweep and CW operation.
Center Frequency control, capacitors C-314, 315	Variable	The Center Frequency control is used to adjust the center frequency of the swept output, or the output frequency when the instrument is being operated in the c-w mode.
Linearity Adjust pot, R-334 (int.)	Variable	This internal control (located on top of the chassis) is used to adjust the frequency deviation linearity. Proper adjustment results in equal frequency increments being equally spaced along the horizontal axis of the CRO trace.
METER ADJ pot, R-351	Variable	This internal control is used to calibrate the output meter and is connected in series with it, thus controlling the current through the meter.

TERMINAL	FUNCTION
Marker RF Out jack, J-5.	An rf signal, of the same frequency as that appearing at the RF OUT jack on the Vari-Sweep 860D, is available at this jack. A connection is normally provided between J-5 on the P-860 and the input terminal on an auxilliary marker generator, such as the Kay Vari-Marker Model F to produce a variable marker.

CIRCUIT DESCRIPTION.

The basic circuits of the P-860 consist of a sawtooth amplifier, r-f oscillator and agc detector. The sawtooth generator, agc amplifier and control stages, attenuator and gain control, plus power supply, are contained in the rack units which accept the P-860 plug-in. Circuitry for the P-860 is shown on Schematic D-7367.

The sawtooth signal (developed by the sweep generator circuits in the 860-D rack unit) is amplified by sawtooth amplifier V-301. This sawtooth signal is then used to vary the current through saturable reactor L-303, since it is in series with the plate supply for V-301. The inductance of the oscillator tank coils, L-304 thru L-315, changes in accordance with the current through L-303, thus changing the frequency of oscillators V-302, V-303.

A negative blanking pulse, taken from diode D-1, is applied to the grids of the oscillators to turn them off during sweep retrace time, thus producing a zero-voltage reference baseline on the CRO.

The output signal from the plug-in is sinusoidal and varies in frequency (swept) as determined by the current through V-301, and the instantaneous inductance of the oscillator tank coils. Output is taken from the pick-off loops (B) and applied to the output circuits through J-4.

Automatic gain control is achieved by taking a sample of the output signal available at J-4 and coupling it through R-346 to a voltage-doubler detector circuit composed of diodes D-303, D-304 and capacitors C-312, C-313. The resultant rectified voltage is applied to the grid of agc amplifier V-3, amplified, and d-c coupled to the grids of parallel-connected cathode-follower output stage V-4. The voltage appearing at the cathodes of V-4 is used as the plate voltage for oscillators V-302, V-303, providing a servo-loop to maintain signal output steady.

When the manual sweep mode is used, current through saturable reactor L-303 is varied in accordance with the setting of the Manual Sweep control (R-38) due to the d-c coupling. The frequency range of the Manual Sweep control is determined by the setting of Sweep Width control R-40, the range selected by the Band Selector, and the setting of the Center Frequency control.

During c-w operation, the sweep generator circuits are inactive, and a steady current flows through the saturable reactor and V-301, permitting the oscillator (V-302, V-303) to oscillate at a frequency determined by the plate tank coil in the circuit, and the setting of the Center Frequency control (C-314A, C-315A).

TEAR OFF AT THIS LINE

We would like to maintain contact with the people who use or fix our instruments. Would you please complete the following and return to us–

Your Name.....

Company .....

Div. or Dept. .....

Street .....

City, Zone, State .....

Telephone No. .....

8602

Do you use this instrument? ..... ☐

Maintain or repair it? ..... ☐

Should we be doing something to help you?.....

.....

.....

Send extra manual on Model..... .

Send general data..... ☐

38189